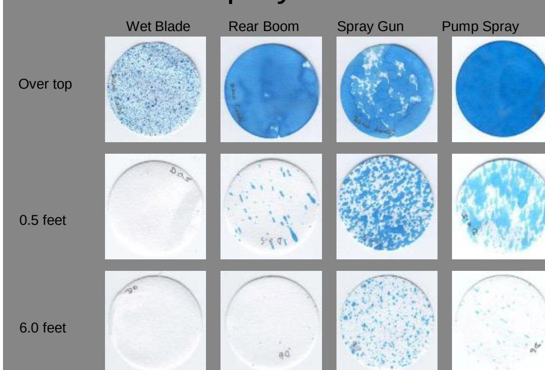
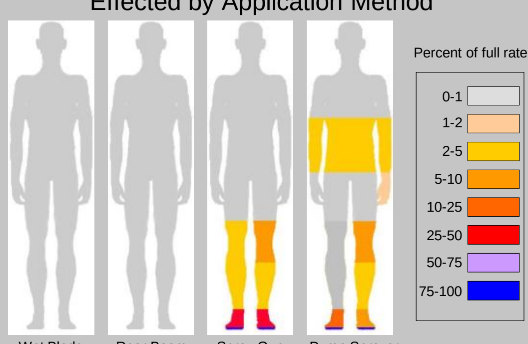
Spray Drift & Worker Exposure

Spray Drift



Worker Exposure to Chemical Solution as Effected by Application Method



Environmental Fate of Herbicides

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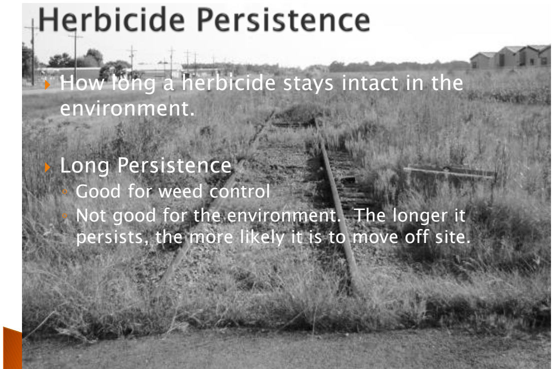
What is Environmental Fate?

- Simple definition: what happens to the herbicide after it leaves the sprayer

Fate of a herbicide

- Persist
- Degrade
- Move

Herbicide Persistence



- How long a herbicide stays intact in the environment.
- Long Persistence
  - Good for weed control
  - Not good for the environment. The longer it persists, the more likely it is to move off site.

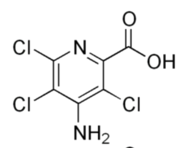
Persistence–Herbicide ½ Life

- How long do herbicides persist
  - Depends on the properties of the herbicide

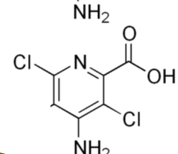
Half-life. Amount of time it takes a herbicide to reach one-half (t1/2) of the originally applied concentration. Expressed in days, weeks, months, years.

1.0 lb. Ai/acre → 0.5 lb. Ai/acre

Small changes can make big differences



Picloram – half-life 90 days (Tordon)



Aminopyralid – half-life 30 days (Milestone VM)

Preemergence Herbicides – Avg. t-1/2

Herbicide	Soil Persistence t-1/2
Atrazine	60 d
Bensulide	120 d
Isoxaben	50 - 120 d
Pronamide	60 d
Metolachor	15 - 50 d
Simazine	60 d
Metribuzin	14 - 28 d

Postemergence Herbicides – Avg. t-1/2

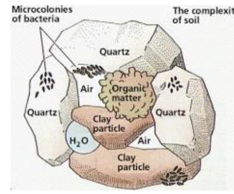
Herbicide	Soil Persistence t-1/2
2,4-D	10 d
2,4-DP	10 d
MCPA	6 d
MCPP	21 d
Dicamba	21 - 84 d
Triclopyr	10 - 46 d
Clopyralid	40 d

Persistence

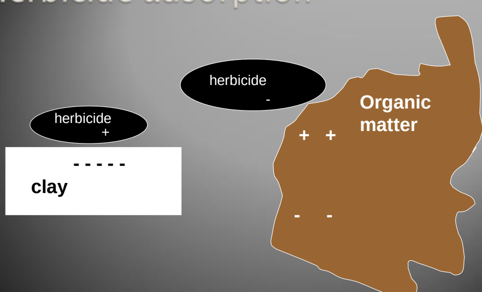
- May persist by adsorption
  - *Adsorption*: the association of molecules with the surfaces of solids.
  - Depends on the properties of the herbicide and the soil

Soil Components

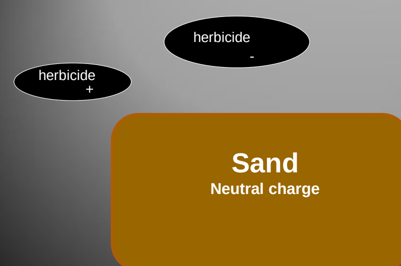
- Solid phase (sand, silt, clay, humus – decayed organic matter)
- Liquid phase (water held in soil spaces)
- Gaseous phase (air in soil spaces)
- Biological phase (bacteria, fungi, protozoa, algae, animals)



Herbicide adsorption



Herbicide adsorption



Degradation

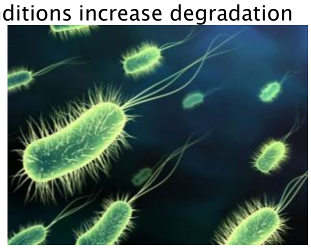
- The herbicide is broken down and no longer possess herbicidal activity
- Processes include:
  - Microbial – deactivated by soil microbes
  - Hydrolysis – reaction with water
  - Photolysis – deactivated by light

Degradation

- The herbicide is broken down and no longer possess herbicidal activity
- Processes include:
  - Microbial – deactivated by soil microbes
  - Hydrolysis – reaction with water
  - Photolysis – deactivated by light
- Given time, the molecule becomes CO_2

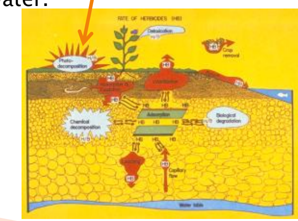
Microbial

- Herbicide broken down by microorganisms
- Fungi and bacteria
- Warm, moist conditions increase degradation



Photolysis

- Herbicide broken down by light
- This is why fluridone (Sonar) will persist longer in muddy water.



Hydrolysis

- Herbicide broken down by water
- After mixing in the tank
- After application in soil water

Movement

- If degradation is slow, the more opportunity the herbicide will move off-site
  - Runoff – surface water contamination
  - Leaching – ground water contamination
  - Volatility – non-target injury

Runoff

- Runoff occurs when the amount of rainfall of irrigation exceeds the normal infiltration rate

Runoff-lateral movement

Lateral movement is bad

Movement-Leaching

- Leaching is when a herbicide moves deep into the soil as water moves through the soil.
- Why would a herbicide leach?
  - Low clay and organic matter content in soil
  - Highly water soluble herbicide
  - Doesn't bind tightly to soil
  - Long soil persistence

Movement-Volatility

- *Volatilization*- The change from a liquid or solid to a gas

Herbicide	Vapor pressure (mm Hg)	Relative Volatility
Fluridone (Sonar, etc.)	1×10^{-7}	Very low
Glyphosate	1×10^{-7}	Very low
Imazapyr (Habitat)	2×10^{-7}	Very low
Triclopyr amine (Garlon 3A) Triclopyr ester (Garlon 4)	3×10^{-7} 3×10^{-6}	Very low Low
2,4-D amine 2,4-D ester	8×10^{-6} 1×10^{-2}	Low Very high
Dicamba (Veteran)	9×10^{-6}	Low

Movement-Volatility

- In general, pesticides are volatilized from plant surfaces to a greater extent and faster than from the soil
- Volatilization continues for from a few days to several weeks (or sometimes even more), occasionally displaying a diurnal cycle
- May lose 10 to 90% of applied dose over course of season

Conclusions

- Herbicides can persist, degrade, or move in a landscape depending on the properties of the chemical and the environment.
- Most of the herbicides we use today have a relatively short life in the environment.
- If they are found to persist too long, they will not be granted registration by EPA.
- Degradation of a herbicide in the environment occurs by microbes, light, or chemical reactions in the water.